THE COMPUTER SECURITY GROUP AT UC SANTA BARBARA

Δ / Delta

Automatic Identification of Unknown Web-Based Infection Campaigns

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CCS 2013 / Session 1-C / Malware

Motivation

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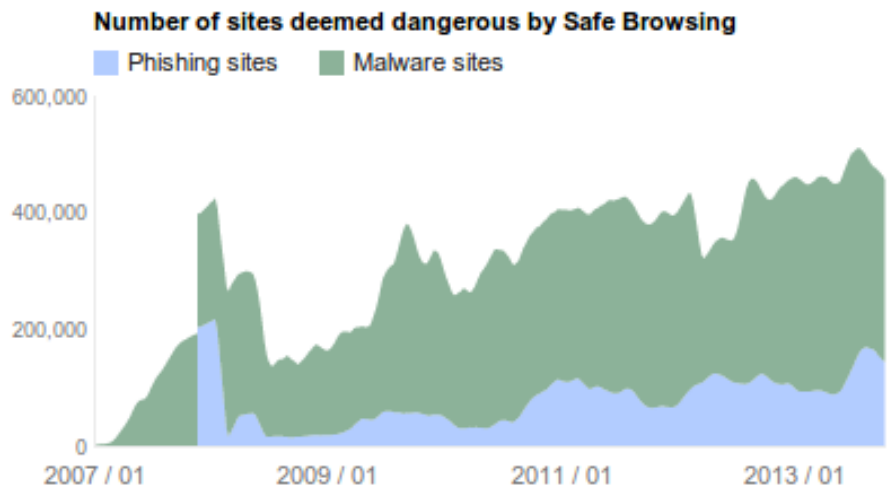
A large campaign infects more than **106,000 unique sites in July**, directing people to sites launching the Blackhole Exploit Kit.

A campaign targeting vulnerabilities in Java and Acrobat Reader infects more than **7,500 sites**. As a result, more than **28.6 million Safe Browsing API users** receive malware warnings **during this week**.

Motivation

- Increasing number of compromised websites each year
- Web being used more and more
- Prior work detects if website is malicious



Infection Vector and Campaign

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<iframe src='http://wsfgfdgrtyhgfd.net/adv/193/new.php'></iframe>
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visits

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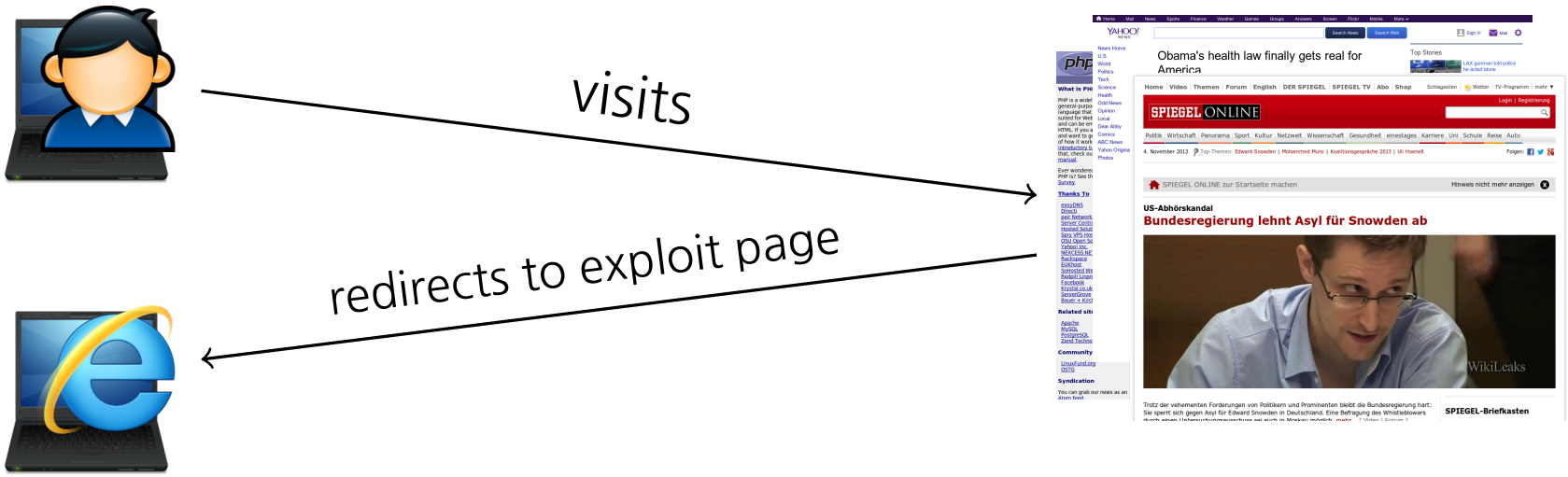

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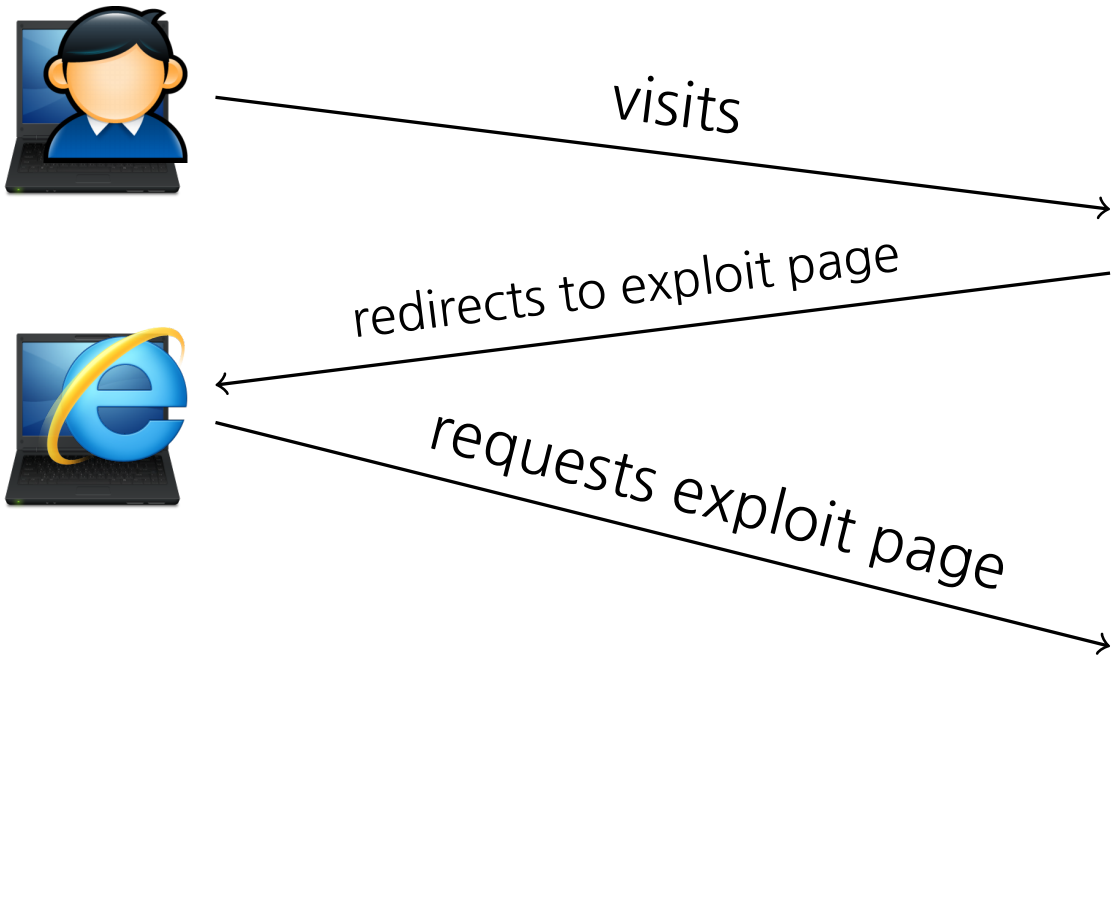

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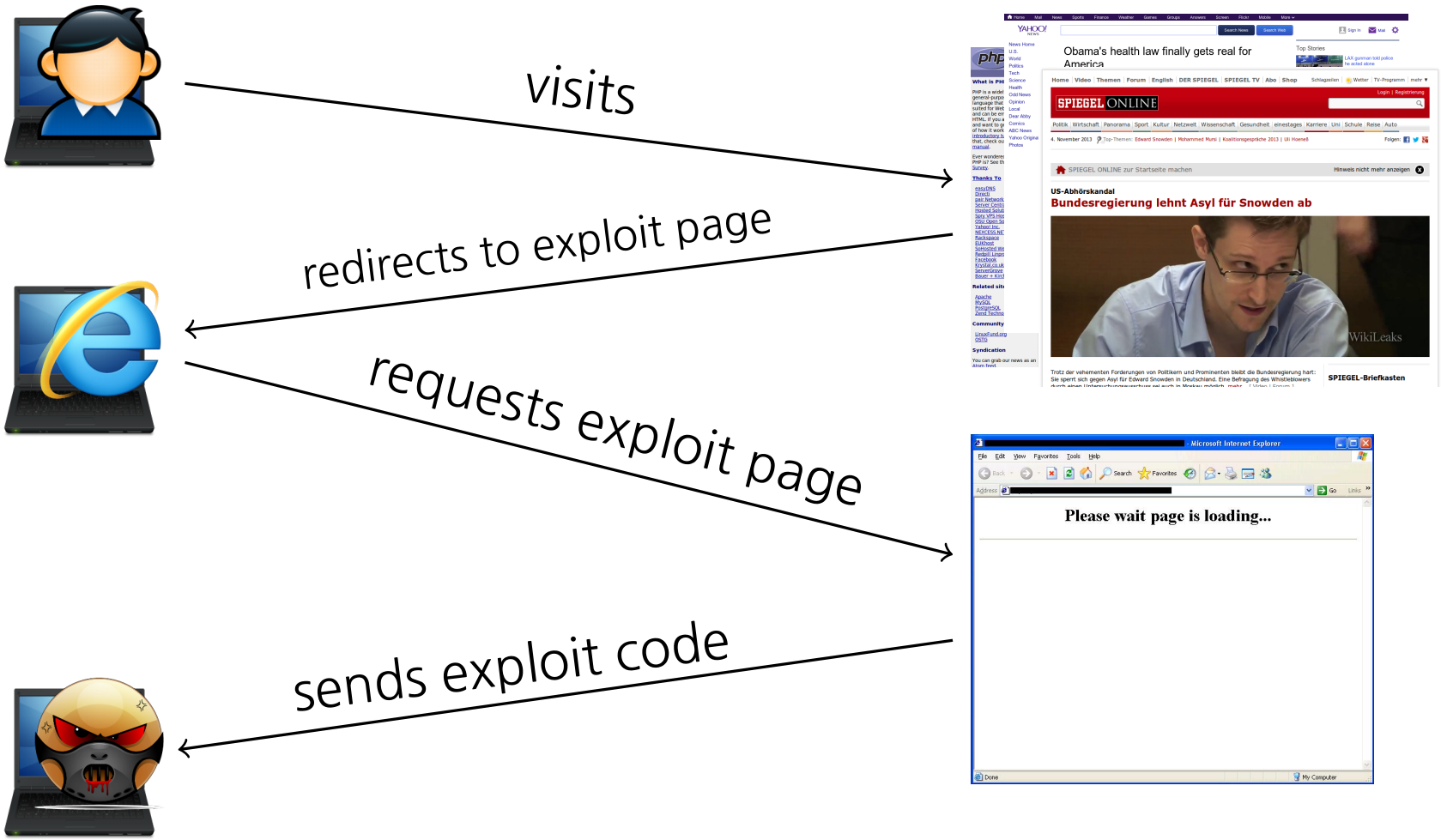

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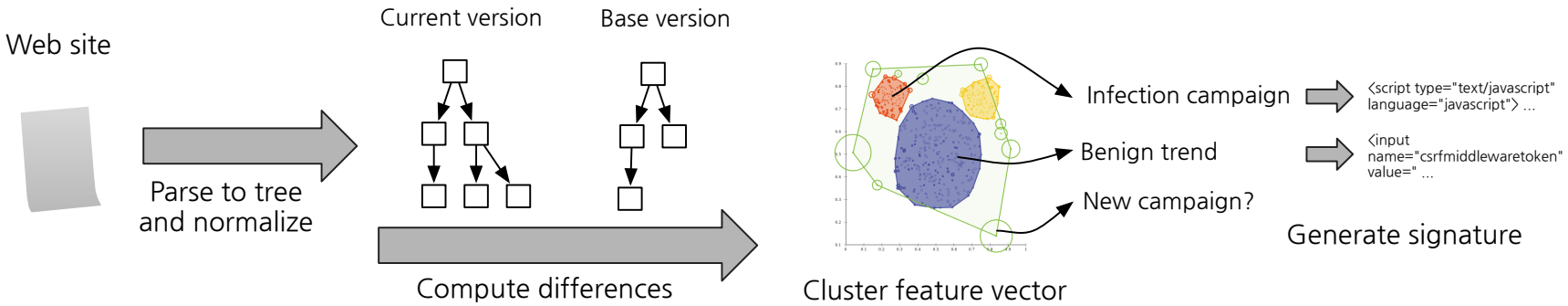
- Cluster similar modifications together
- Analyze if cluster is malicious or not
- Generate signature as model of the campaign

Delta - Approach



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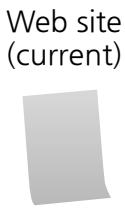

- No client-side script execution
  - Snapshot problem

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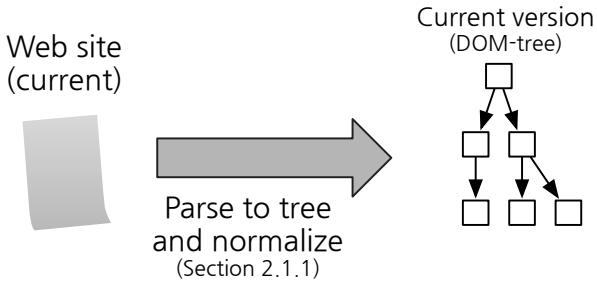

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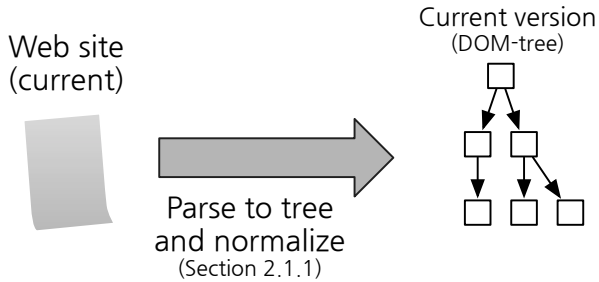


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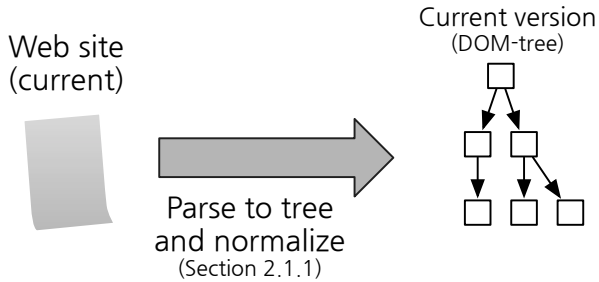


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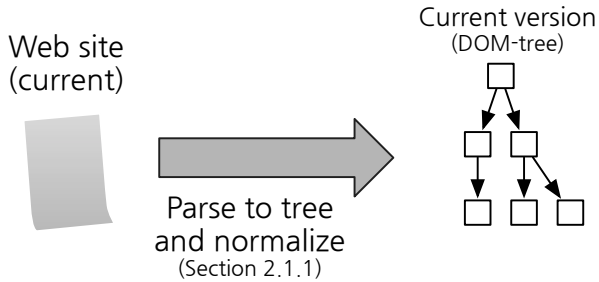


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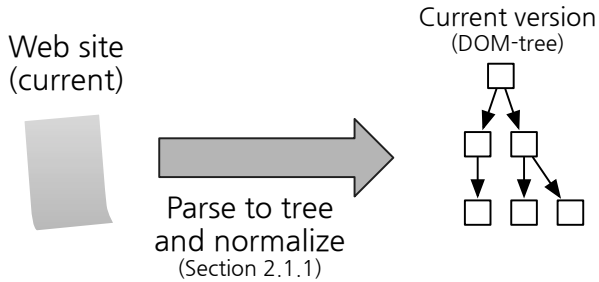


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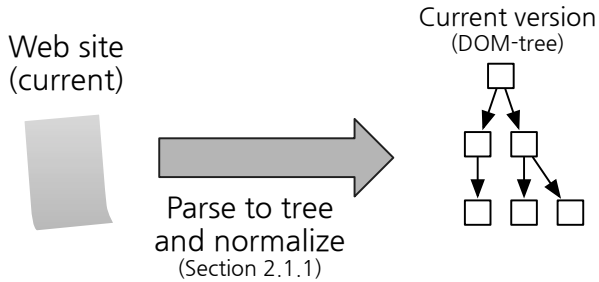


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Normalization

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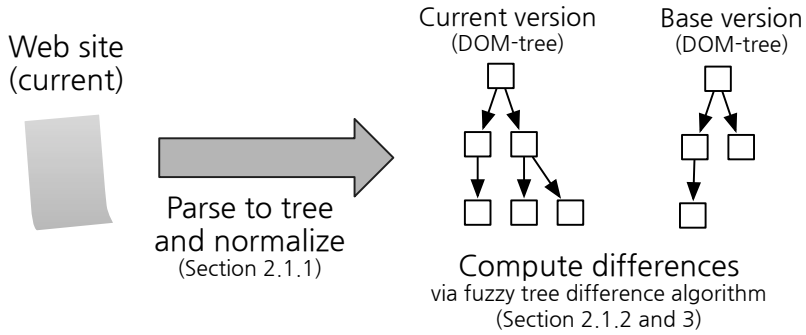
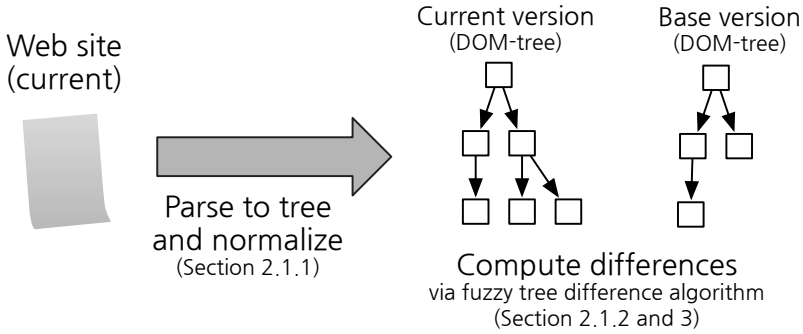
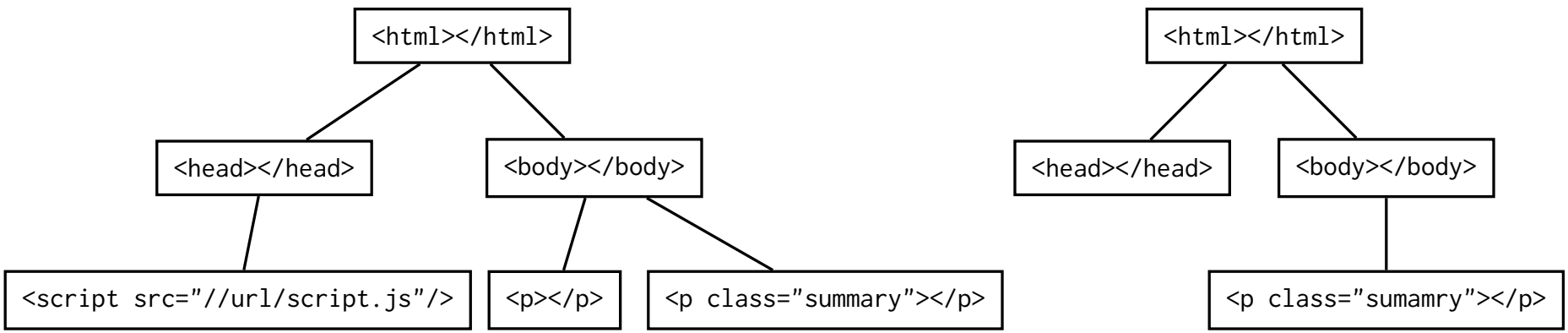


Fuzzy-tree difference:

- Tree is considered unordered
- Fuzzy on normalized tags (Jaro distance)

Delta - Approach





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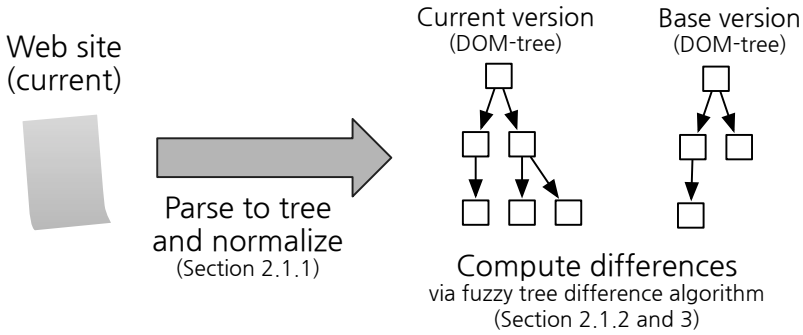

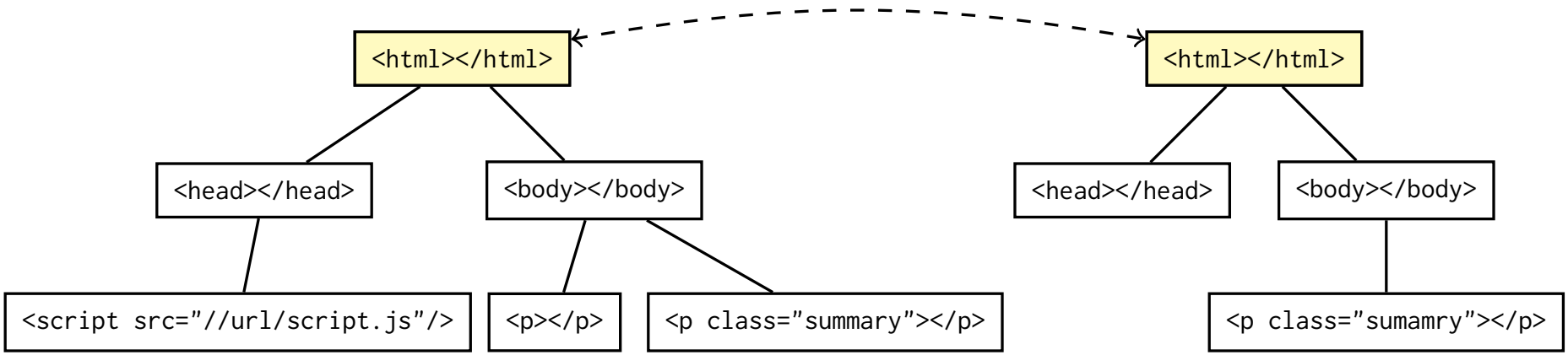

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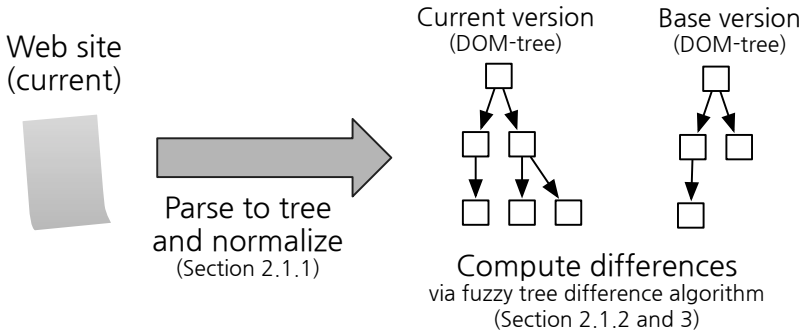

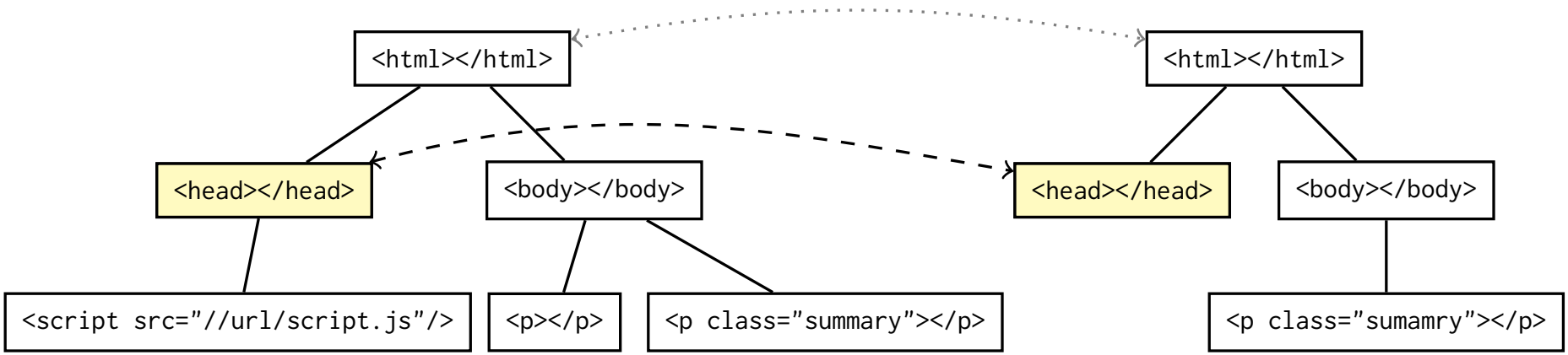

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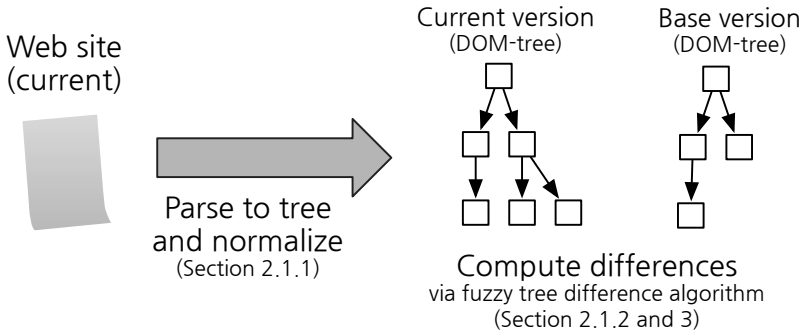

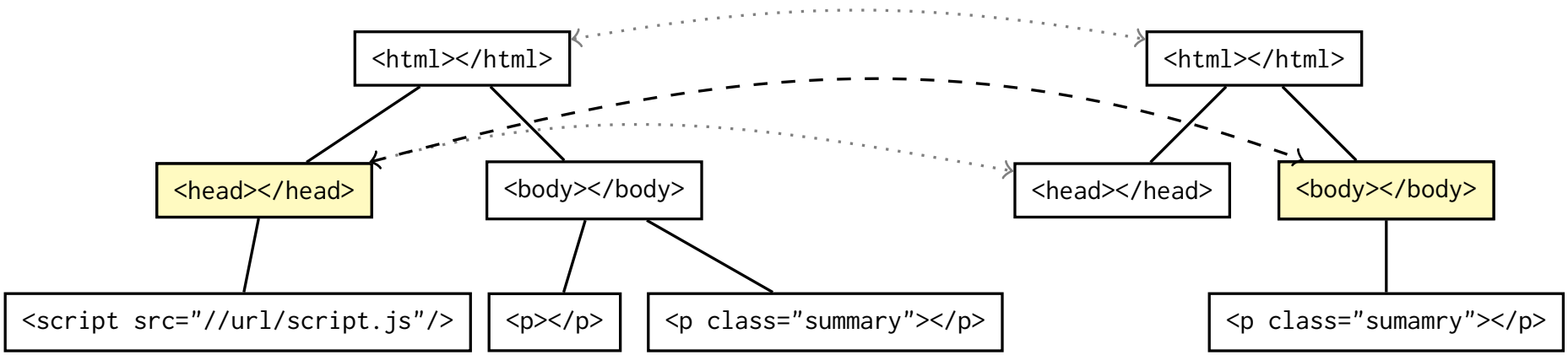

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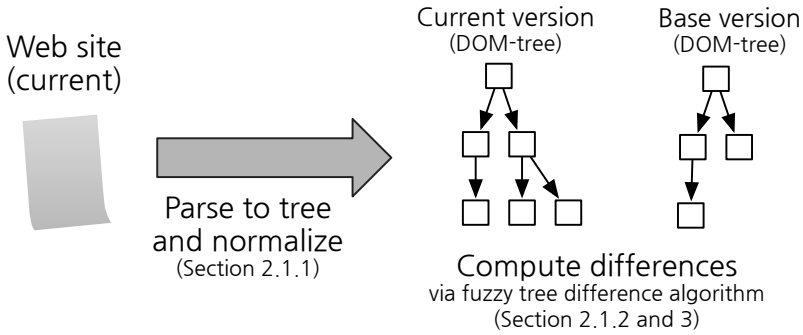

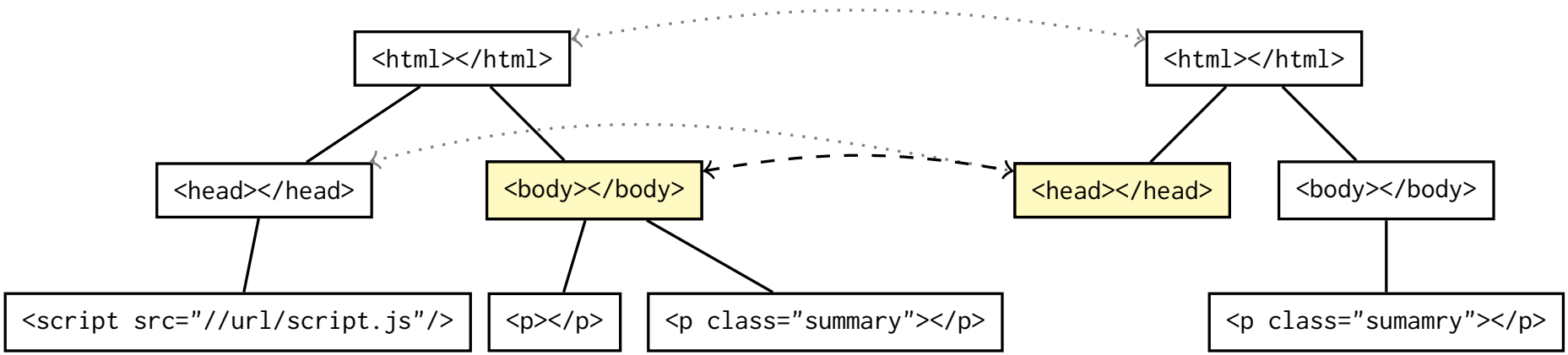

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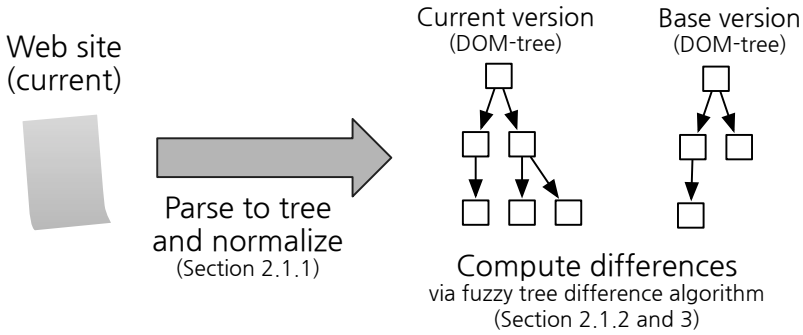

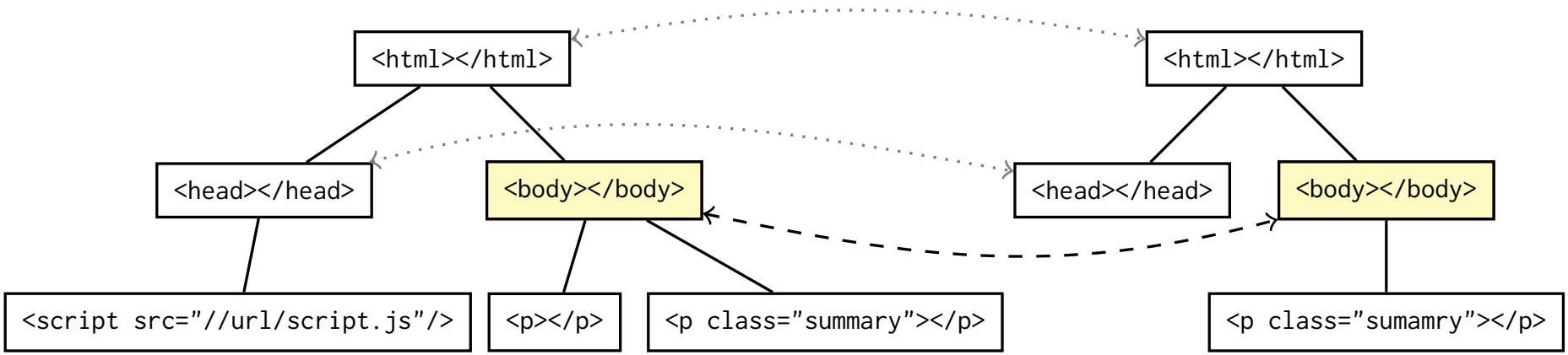

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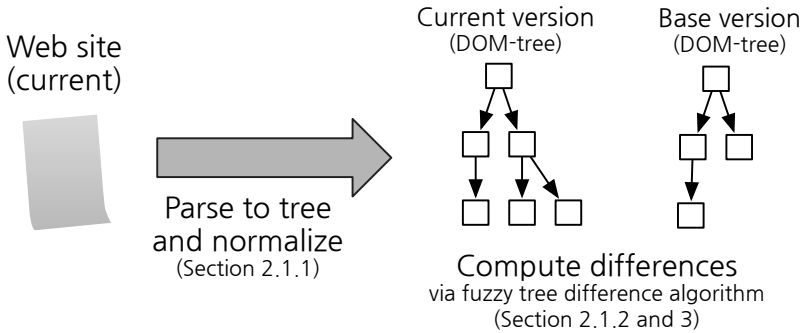

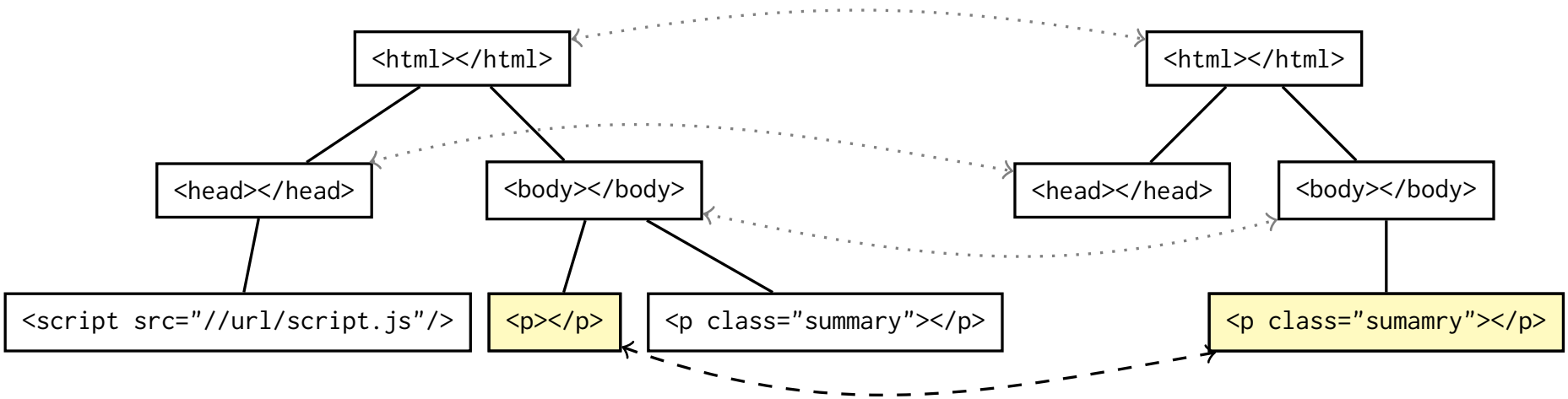

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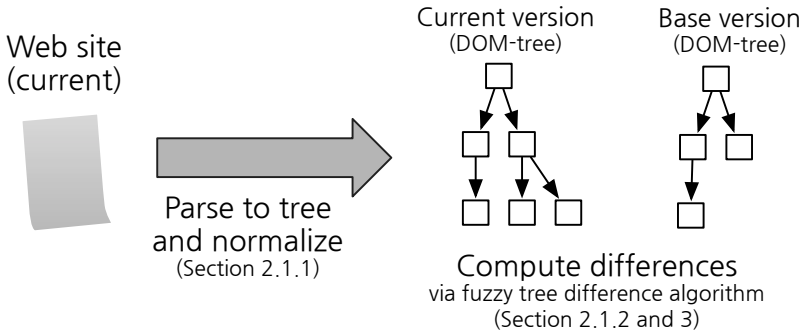

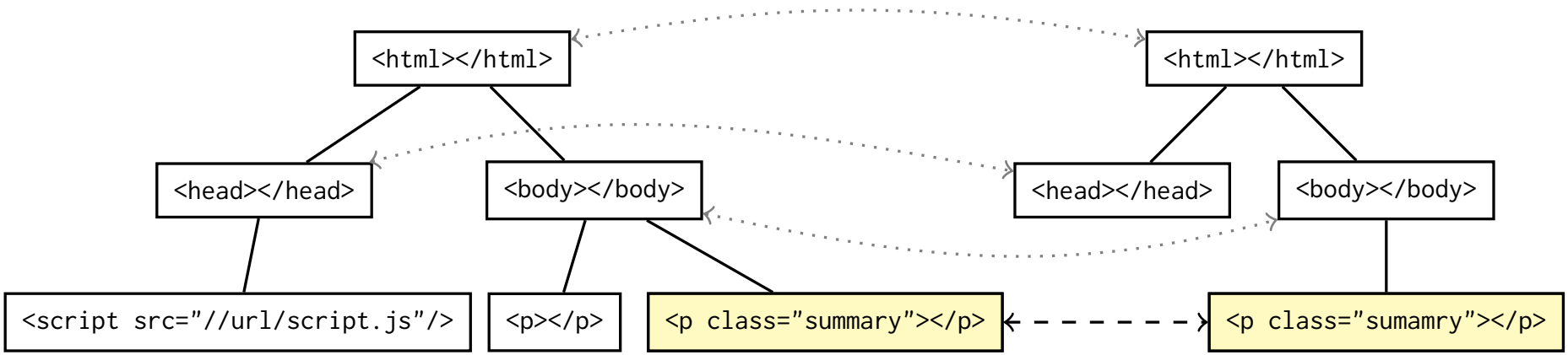

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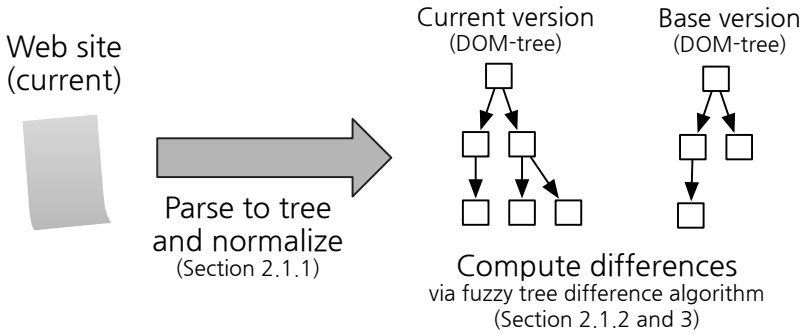

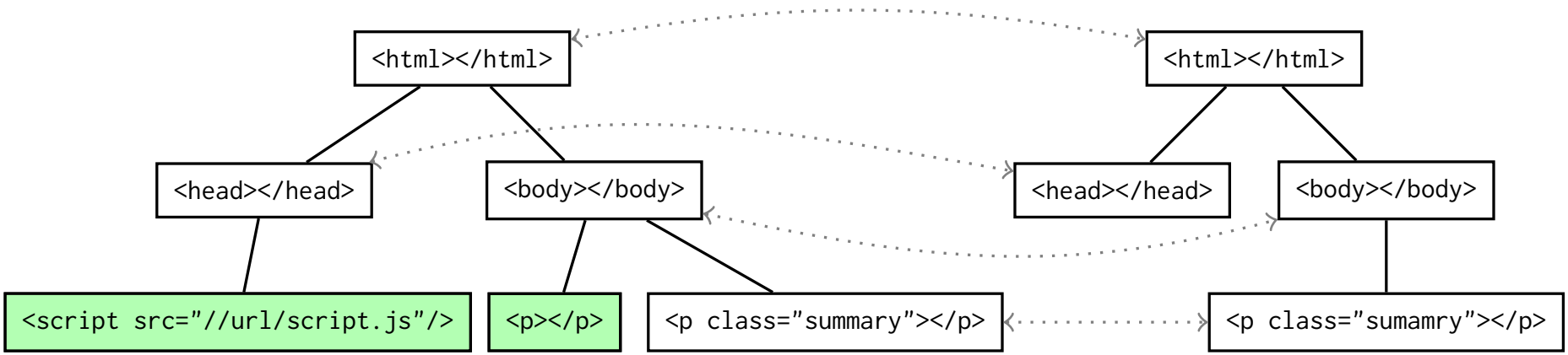

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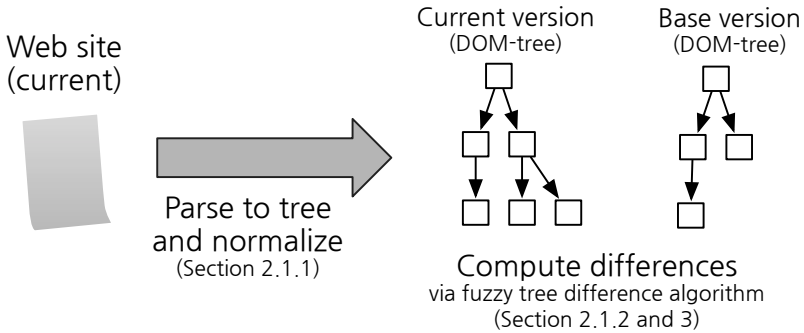


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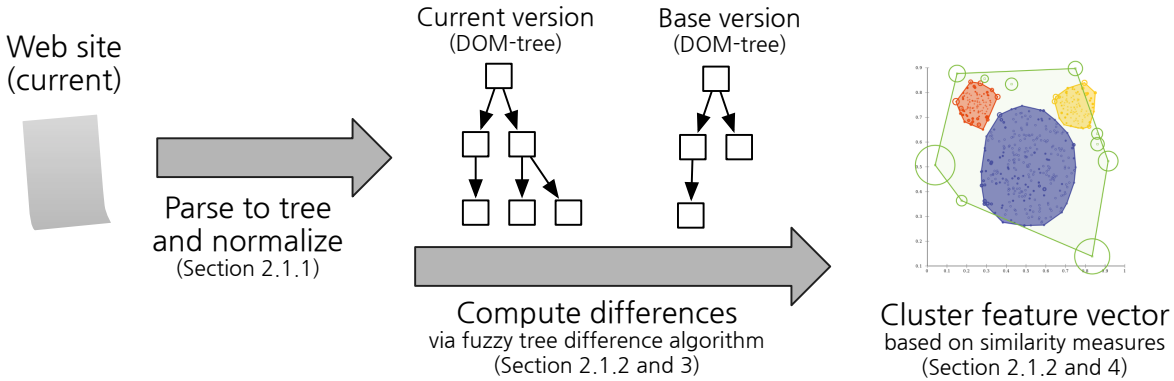

Similarity measures

- Template propagation
- Shannon entropy
- Character count/distribution
- Approx. Kolmogorov complexity
- Script inclusion
- …

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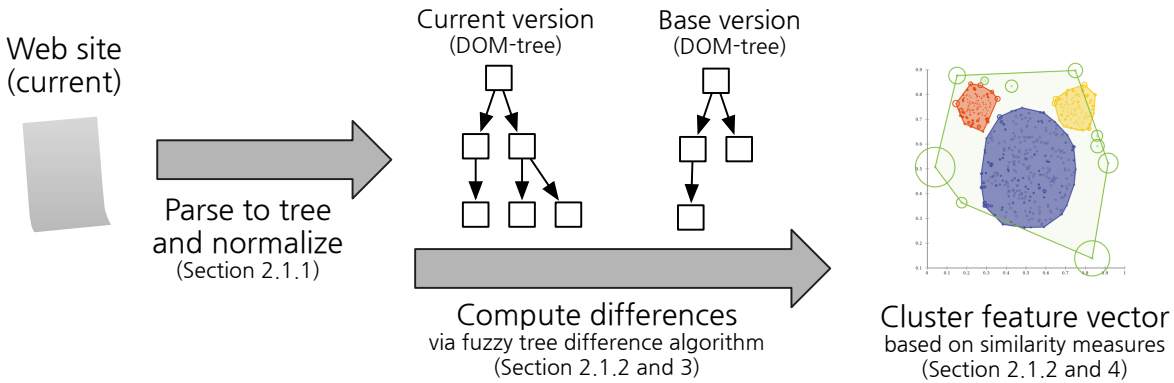

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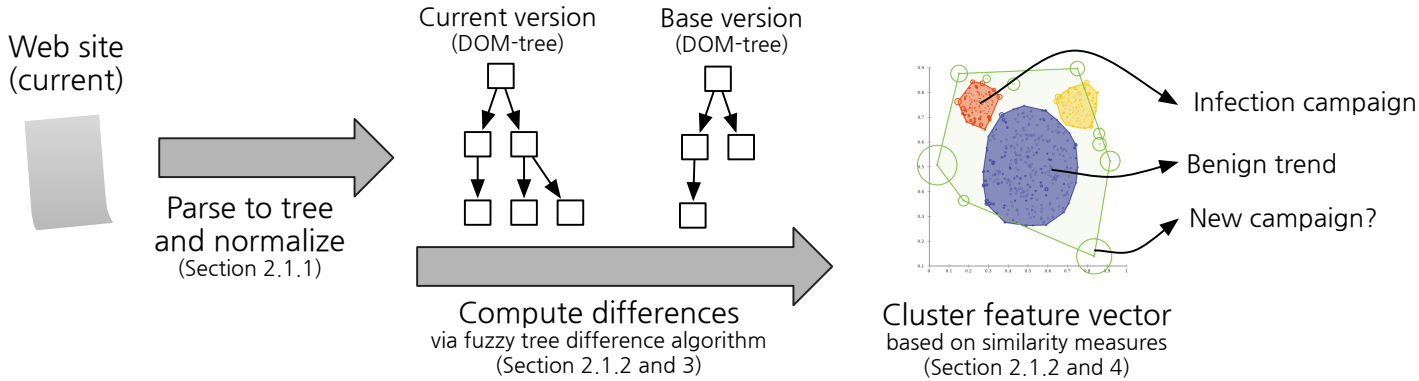
~250 dimensional feature space

Delta - Approach



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- Classify behavior for samples
- Assign label to cluster

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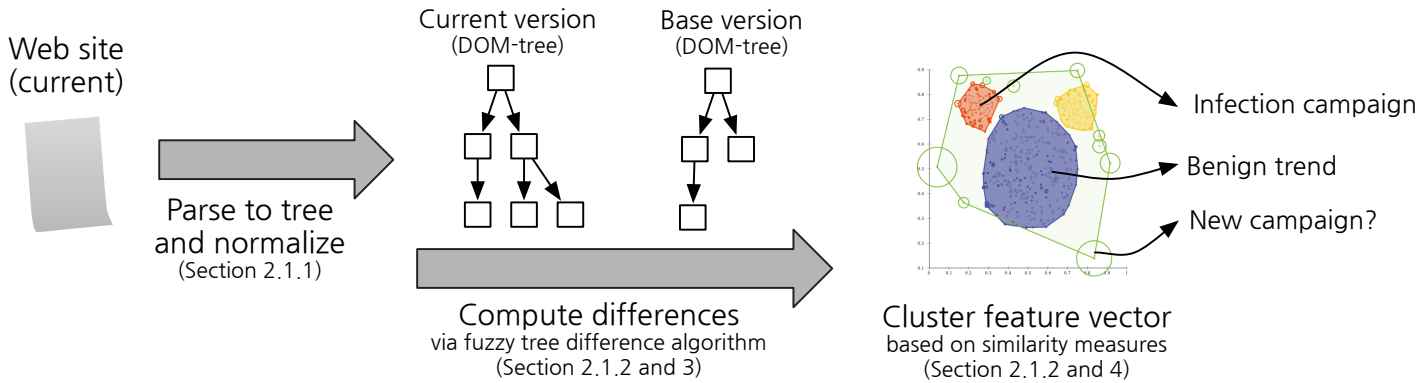

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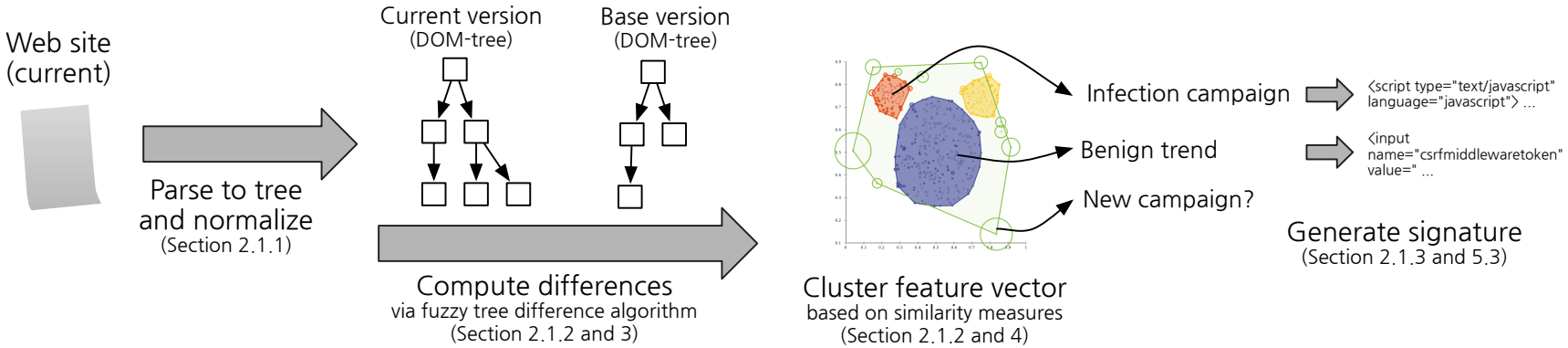
- Density-based clustering
- Outliers acceptable

Delta - Approach



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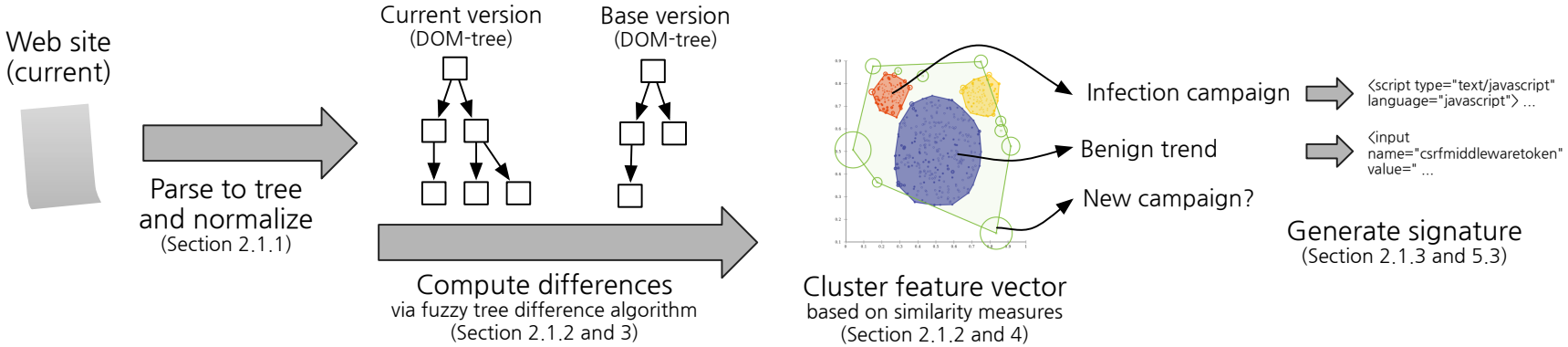


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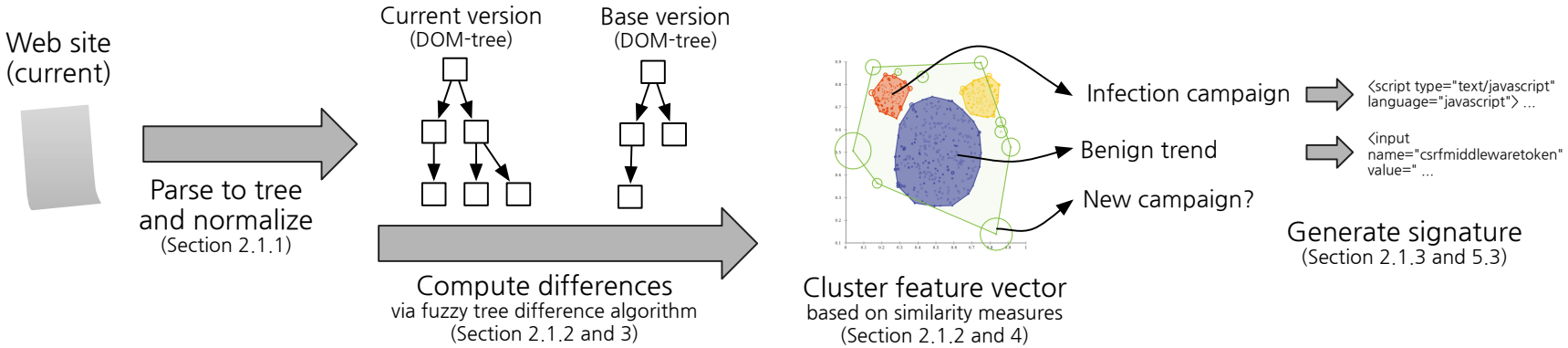


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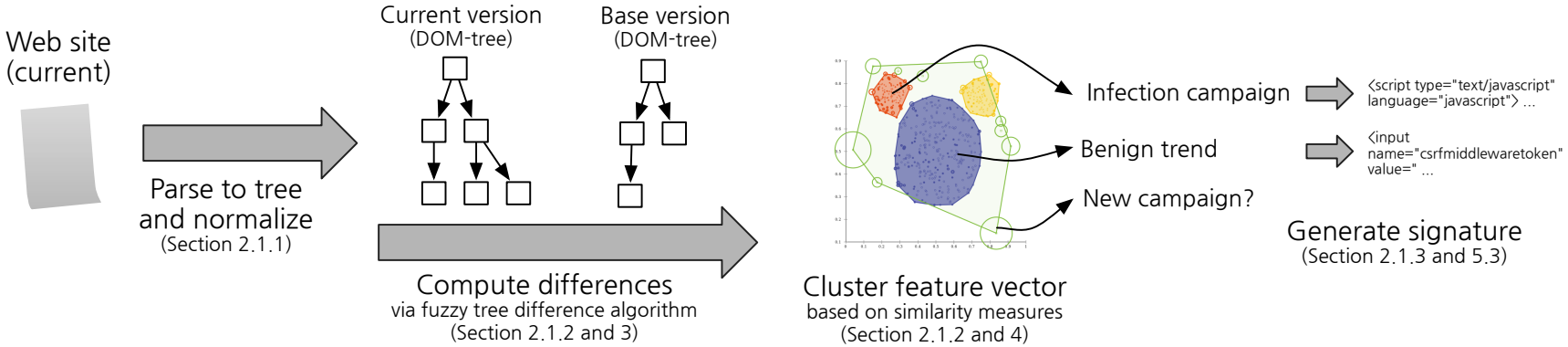


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⇓

Signature generation

⇓

```
<script src="http://(a(b|d)c.org/2fcab50
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                    |abc.net/2fcab50)712467eab4004583eb8fb7f89.js"/>
```

Delta - Applications

Detecting infection campaigns:

- New cluster (mostly) malicious?
  - New campaign
- Malicious modification inserted?
  - Campaign spreads
  - Also works when exploit pages are (currently) offline
- Malicious modification removed?
  - End of campaign (potentially)

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Understanding infection campaigns:

- Same web applications serving malware?
- Same software stack?
- Users with the same browser targeted?
- Users speaking the same language targeted?
- Only users from a set of IP addresses targeted?
- Same shared hosting provider?

Evaluation

Delta paired with a web crawler

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- From January 2013 to May 2013
- Over 12 million unique URLs (max 10 pairs per URL)
- Over 26 million unique pairs of websites (~700GiB)
- Hourly seed: Twitter's trending topics
  - URLs in tweets
  - Yandex's results
- 15 minutes to 1 week recrawl delay

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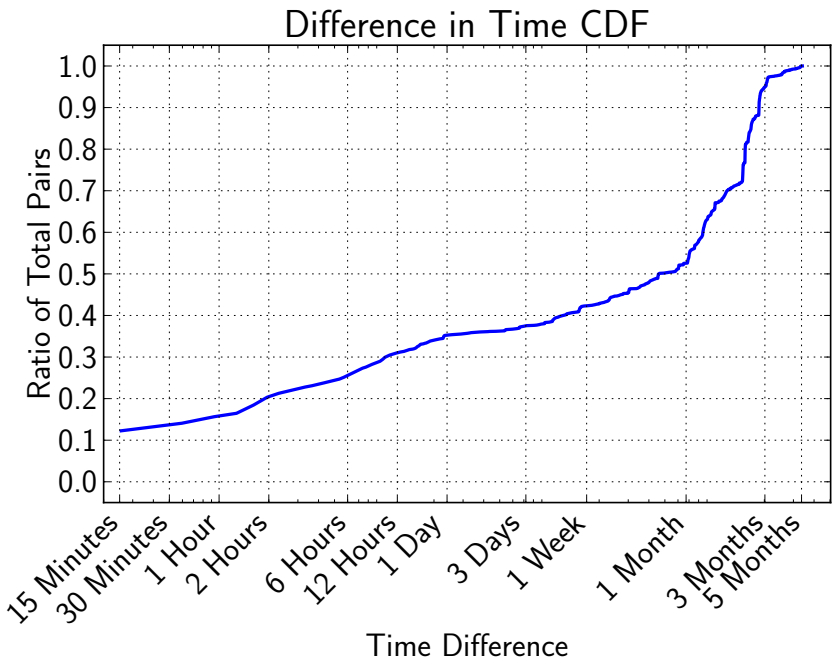

Performance

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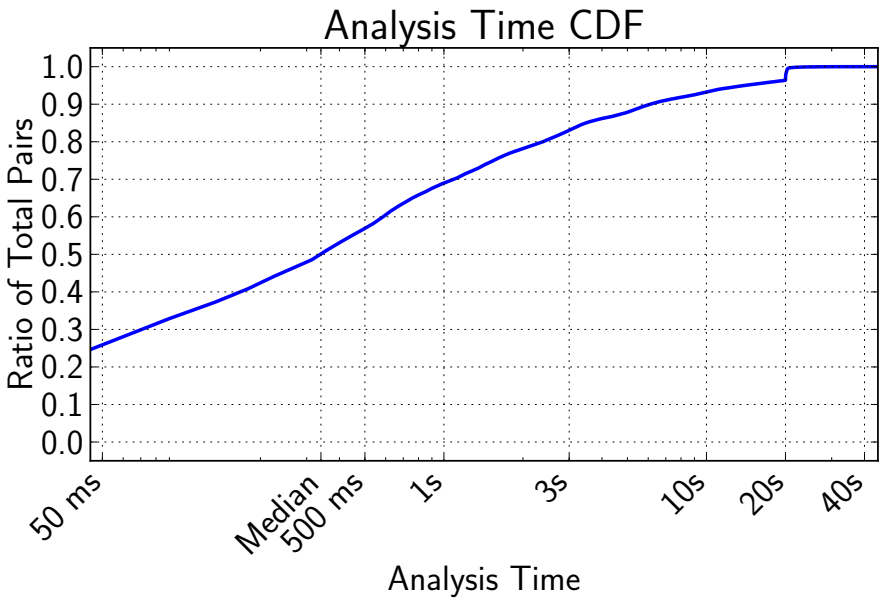

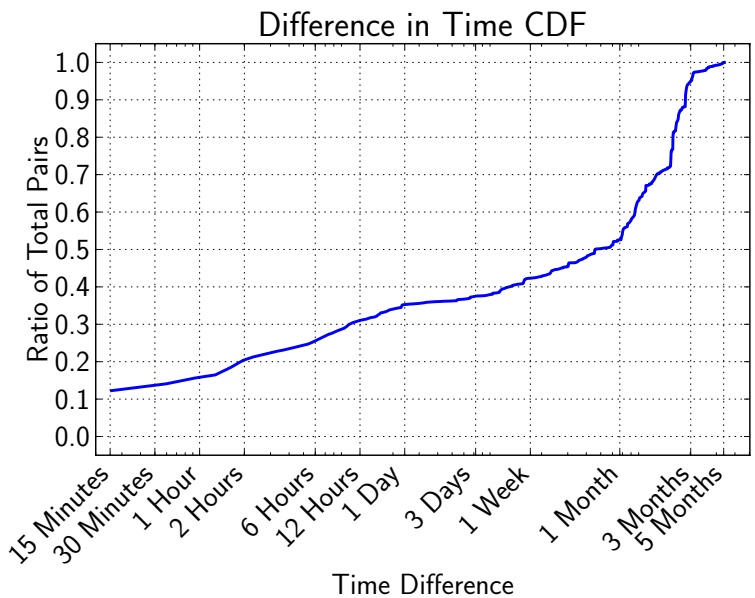

Clusters

- ~67,000 clusters of modifications
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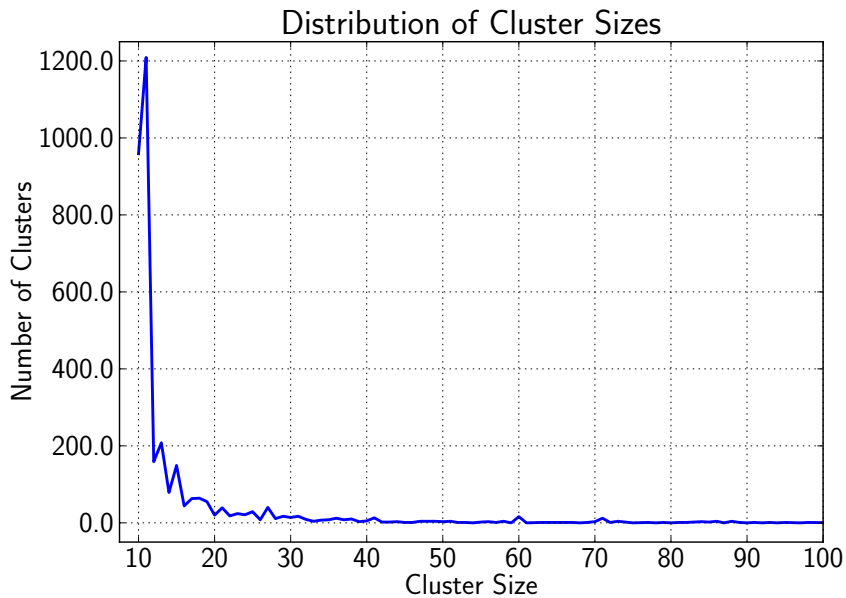

Cool Exploit Kit

- Redirection to Cool Exploit Kit installation via JavaScript
- Active in April 2013

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```
<script type
    ="text/javascript" language="javascript">
  p=parseInt;
  ss=(123) ? String.fromCharCode : 0;
  asgq=" [4036 character obfuscated string] "
       .replace(/@/g,"9").split("!");
  try { document.body&=0.1 } catch(gdsgsdg) {
    zz=3; dbshre=79;
    if(dbshre) { vfvwe=0;
      try { document; }
      catch(agdsg) { vfvwe=1; }
      if(!vfvwe) { e=eval; }
      s="";
      if(zz) for(i=0;i-1374!=0;i++) {
        if(window.document)
          s+=ss(p(asgq[i],16)); }
      if(window.document) e(s); }}</script>
```

Me Gusta

- Found on El Huffington Post
- From January 2013 to May 2013

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  with a return link similar to
  `http://www.huffingtonpost.es/2013/04/03/42173.html`

What we have covered:

- Delta approach
  static analysis leveraging web-dynamics to identify unknown infection vectors and support manual analysis
- Practicality
  paired with crawler showed large-scale applicability

Thanks!

Questions?

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